A-36

2-Magnon Peak in $La_{2-x}Sr_xCuO_4$ Observed with RIXS at the Cu K-edge

D. S. Ellis[1], Jungho Kim[1], J. P. Hill[2], S. Wakimoto[3], R. J. Birgeneau[4], Y. Shvyd'ko[5], D. Casa[5], T. Gog[5], K. Ishii[6], K. Ikeuchi[6], A. Paramekanti[1], and Young-June Kim[1]

[1]Department of Physics, University of Toronto, Toronto, Ontario, Canada M5S 1A7
[2]Department of Condensed Matter Physics and Materials Science, Brookhaven National Laboratory, Upton, NY 11973
[3]Quantum Beam Science Directorate, Japan Atomic Energy Agency, Tokai, Ibaraki 319-1195, Japan
[4]Department of Physics, University of California, Berkeley, CA 94720-7300
[5]XOR, Advanced Photon Source, Argonne National Laboratory, Argonne, IL 60439
[6]Synchrotron Radiation Research Center, Japan Atomic Energy Agency, Hyogo 679-5148, Japan

We present a comprehensive study of the temperature and doping dependence of the 500 meV peak observed at $q=(\pi 0)$ in resonant inelastic x-ray scattering (RIXS) experiments on La_2CuO_4. The intensity of this peak persists above the Néel temperature (T_N=320K), but decreases gradually with increasing temperature, reaching zero at around T=500K. The peak energy decreases with temperature in close quantitative accord with the behavior of the two-magnon B1g Raman peak in La_2CuO_4 and with suitable rescaling, agrees with the Raman peak shifts in $EuBa_2Cu_3O_6$ and K_2NiF_4. The overall dispersion of this excitation in the Brillouin zone is found to be in agreement with theoretical calculations for a two-magnon excitation. Upon doping, the peak intensity decreases analogous to the Raman mode intensity and appears to track the doping dependence of the spin-correlation length. Taken together, these observations strongly suggest that the 500 meV mode is magnetic in character and is likely a two-magnon excitation.